

IAP15 Rec'd PCT/PTO 12 JAN 2006

REINHOLD COHN & PARTNERS
PATENT ATTORNEYS

Established 1934

February 17, 2005

Registered mail with confirmation of delivery

Att.

Mr. Boaz Cohen
3/4 Harav Kook St.
Hadera 38133

Dear Mr. Cohen,

**Re: U.S Patent Application, based on International
Application No. PCT/IL20 04/000584
"Rotary Sprinkler with Reduced Wear"
In the name of NETAFIM (A.C.S) LTD.
Inventor: Boaz Cohen
Our Ref: 154724-9 (please cite)**

The above International Application was submitted on July 1, 2004. At the date of the Application's submission, you should have, as the inventor, to sign the Application form before its submission, and so you did. In addition, as an employee of Netafim, you signed a transfer of rights in the invention to Netafim in order to submit the Application in the USA. Attached is the transfer document.

In order to complete the submission of the Application in USA we need your declaration that you are indeed the sole and true inventor. Attached is the declaration form with a power of attorney, which we request you to sign, in the framework of the obligation according to Article 140 of the Patents Law of 1967.

For your information, said article of the Law stipulates that when a person invents a service invention in which the ownership was transferred to his employer, he must do whatever is required from him in order to protect the invention, in any place whatsoever and to sign any document required thereof. If you need any clarifications, please contact me to telephone number 03-7109302.

We would be grateful if you return the **original** of said form (by regular mail), after being signed as required, **within two week from the receipt of this letter.** For your convenience, attached is a stamped envelope, addressed to our office. In addition, please send a signed copy of this power of attorney to fax number 03-7109310.

Attached is also a copy of said Application, that you were involved in its preparation as inventor.

BEST AVAILABLE COPY

Yours sincerely,
Reinhold Cohen & Partners, by:

Ena Pugatsch, Patent Attorney

Copies without attachments:

Adv. Maayan Bar, General Counsel , Netafim

Mr. Koby Millo, VP for R&D, Netafim

Mr. Eliezer Kelmschas, Netafim

Mr. Erez Zimchoni, Intellectual Property & Development Innovation Manager,
Netafim

ריינהולד כהן
ושותפיו
עורכי פטנטים
נוסד 1934

רשום עם אישור מסירה

ח' באדר א, תשס"ה
17 בפברואר, 2005

לכבוד
מר בועז כהן
רח' הרב קוק 3/4
חדרה 38133

מר כהן הנכבד,

הנדון: בקשת פטנט בארה"ב המבוססת על
בקשה בינלאומית מס. PCT / IL2004/000584.
"ממטירון מסתובב בעל בליה מוקטנת ממטירון מסתובב בעל
שחיקה ובליה מוקטנת"
בשם NETAFIM (A.C.S.) LTD
ממציא: בועז כהן
מספרנו: 9-154724 (נא לצטט)

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Website: www.rcip.co.il
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כמו כן, מצייב העתק של הבקשה הנ"ל, שבהכנתה היית מעורב כממציא.

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ע"י:

אינה פוגץ', עו"פ

אפ/לג

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ASSIGNMENT

Full Name of Inventor: Boaz COHEN
Citizenship: Israeli
Post Office Address: 3/4 Harav Kook Street
Hadera 38427
ISRAEL

In consideration of the sum of one dollar (US\$ 1.00) and other good and valuable considerations paid to each of the undersigned, the undersigned agree(s) to assign, and hereby do (does) assign, transfer and set over to

Name of Assignee NETAFIM (A.C.S.) LTD.
Agricultural Co-operative Society, of
Address of Assignee 161 Arlozorov Street
Tel Aviv 64922
ISRAEL

(hereinafter designated as the Assignee) the entire right, title and interest for the United States, its territories, dependencies and possessions, in the invention, and all applications for patent and any Letters Patent which may be granted therefor, known as

Title ROTARY SPRINKLER WITH REDUCED WEAR

for which the undersigned has (have) executed an application for patent in the United States of America, the specification of which:

- ☐ is attached hereto.
☒ was filed on 01/07/2004 as Application Serial No. IL2004/000584

1) The undersigned agree(s) to execute all papers necessary in connection with the application and any continuing or divisional or reissue applications thereof and also to execute separate assignments in connection with such applications as the Assignee may deem necessary or expedient or essential to its full protection and title in and to the invention hereby transferred.

2) The undersigned agree(s) to execute all papers necessary in connection with any interference which may be declared concerning this application or continuation or division or re-issue thereof and to cooperate with the Assignee in every way possible in obtaining evidence and going forward with such interference.

3) The undersigned agree(s) to perform all affirmative acts which may be necessary to obtain a grant of a valid United States patent to the Assignee.

4) The undersigned agree(s) to communicate to the Assignee or representatives thereof any facts known to me (us) respecting the invention and improvements thereof, and will, upon request, but without expense to me (us), testify in any legal proceedings regarding the invention.

5) The undersigned hereby authorize(s) and request(s) the Commissioner of Patents to issue any and all Letters Patents of the United States resulting from said application or any division or divisions or continuing applications thereof to the said Assignee, as Assignee of the entire interest, and hereby covenants that he has (they have) full right to convey the entire interest herein assigned, and that he has (they have) not executed and will not execute, any agreement in conflict herewith.

6) The undersigned hereby grant(s) the firm of Nath & Associates, PLLC the power to insert on this assignment any further identification which may be necessary or desirable in order to comply with the rules of the United States Patent Office for recordation of this document.

7) This Assignment shall be binding upon my (our) heirs, executors, administrators, and/or assigns, and shall inure to the benefit of the heirs, executors, administrators, successors and/or assigns of the Assignee.

Full Name of Inventor: Boaz COHEN

Inventor's Signature:

Boaz

Date:

Date

Witness

Erez Zimhoni - IP-Manager R&D Dept

Date

Witness

Tzvi Barkai - R&D Manager

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled ROTARY SPRINKLER WITH REDUCED WEAR, the specification of which:

- ☐ is attached hereto.
☐ was filed on _____ as Application Serial No. _____ and was amended on _____.
☒ was described and claimed in PCT International Application No. IL2004/000584 filed on 01/07/2004 and as amended under PCT Article 19 on _____.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information I know to be material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim the benefit under Title 35, United States Code, §119(e)(1) of any United States provisional application(s) listed below:

U.S. Serial No.	Filing Date	Status

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose all information I know to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56(a) which became available between the filing date of the prior application and the national or PCT international filing date of this application:

U.S. Serial No.	Filing Date	Status

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

Country	Application No.	Filing Date	Priority Claimed
IL	156931	15/07/2003	<input checked="" type="checkbox"/>

Combined Declaration and Power of Attorney

Page 2 of 2 Pages

I/We hereby appoint the Practitioners associated with the following Customer Number:

Customer Number 20529

Direct Telephone Calls to:

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Gary M. Nath
(202) 775-8383

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Full Name of Inventor: Boaz COHEN

Inventor's Signature: _____

Date: _____

Residence Address:

Citizenship:

Post Office Address:

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3/4 Harav Kook Street
Hadera 38427
ISRAEL

ROTARY SPRINKLER WITH REDUCED WEAR

FIELD OF THE INVENTION

This invention relates to rotary sprinklers, in particular to dynamic sprinklers with unlimited speed of rotation where an operating rotor is supported in a thrust bearing.

5 BACKGROUND OF THE INVENTION

Dynamic rotary sprinklers are characterized by high rotational speed, which is due to the lack of braking mechanism. Their advantages lie in the simple construction that accounts for their low price. Their shortcomings are relatively small range (radius) of irrigation and small water droplets emitted as a result of the
10 high speed of rotation.

A typical dynamic rotary sprinkler known in the art is shown in Fig. 1. The sprinkler 10 is made of plastic parts: a sprinkler base 12 mountable to irrigation water pipe (not shown), a thrust bearing 14, a rotor (swivel) 16, and a connecting bridge 18. The base 12 has an axial inlet nozzle 20, a coaxial intermediate bore 22
15 and a coaxial exit chamber 24. The thrust bearing 14 has an axial socket 26 comprising a bore 28 and a bottom 30. The rotor 16 has a base 32 with outlet channel 34, a cap 36, and an axle 38 with a tip 39.

The sprinkler base 12 and the bearing 14 are snapped into the connecting bridge 18 in coaxial relation, with the rotor 16 located between them. The rotor axle
20 38 is received in the socket 26 while the rotor base 32 is received in the intermediate bore 22 so that the rotor may move axially and rotate freely.

In operation, when water jet exits from the inlet nozzle 20, the jet lifts the rotor 16 until the tip 39 of the axle abuts the bottom 30 of the socket, while the base

32 is still in the bore 22. The water jet passes through the curved channel 34 and leaves the rotor spreading in droplets about the surrounding area. The outlet channel 34 has some curvature also in the plane perpendicular to the rotor's axis of rotation, whereby the water jet creates a reactive force that imparts high rotation speed to the
5 rotor.

In still state, the rotor 16 falls down into the sprinkler base 12, whereby the cap 36 closes the exit chamber 24 preventing contamination of the inlet nozzle by external factors (see also Fig. 6). Understandably, in this lower position of the rotor, the axle 38 still remains in the socket 26. The axial distance between the upper and
10 the lower position of the rotor provides for free exit of the water jet from the channel 34.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a rotary sprinkler comprising a rotor with an axle having a tip, and a thrust bearing with a socket
15 having a bottom, the socket being adapted to receive for rotation the axle so that the tip abuts the bottom in a contact zone, wherein the sprinkler further comprises a hard element constituting a part of the bottom or of the tip. The hard element is made of harder material than the axle or the socket, thereby reducing their wear.

The hard element is preferably made of industrial sapphire stone, industrial
20 ruby stone, ceramics, steel, or glass.

The hard element is preferably formed as a flat plate, a concave plate, a pin, or a ball, and its surface in the contact zone is polished.

In one embodiment of the sprinkler, the hard element is a stainless steel ball locked in the bottom of the socket or in the tip.

25 In another embodiment, the rotary sprinkler comprises two hard elements, one at the socket bottom, one at the axle tip.

The above-described construction of the sprinkler provides for reduced friction and improved friction endurance of the rotor axle and the thrust bearing.

According to another aspect of the present invention, the thrust bearing has a socket with an inlet opening of diameter D_0 and a peripheral wall between the opening and the bottom. The socket receives slidably and rotatably the axle through the inlet opening so that the tip can abut the bottom. The tip has diameter D_1 close
5 to D_0 , while an adjacent portion of the axle has diameter $D_2 < D_1$, such that, when the tip abuts the bottom, an open annular gap is formed between the axle and the peripheral wall, and when the tip is aligned with the inlet opening, the inlet opening is essentially closed.

The tip may be formed as a ball, as a cylinder, as a cone, as a disc, or as
10 another body of rotation.

Enlarging the diameter of the rotor axle tip prevents the penetration of contaminating particles into the contact zone of the tip and the socket both in the upper (operative) position of the rotor with the tip abutting the bottom and in the lower position with the tip aligned with the inlet opening of the socket. Since the
15 enlarged tip is relatively short, a contaminating particle is less likely to be trapped between the axle and the socket wall.

Preferably, the rotary sprinkler of the present invention has both a short enlarged tip, and a hard element, to obtain double effect.

BRIEF DESCRIPTION OF THE DRAWINGS

20 In order to understand the invention and to see how it may be carried out in practice preferred embodiments will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1 illustrates a rotary (dynamic) sprinkler known in prior art.

Figs. 2A and 2B show rotor-bearing assembly with a hard disc insert
25 according to the present invention.

Fig. 3 is an enlarged view of the axle tip and the socket bottom with a stainless steel ball insert according to a further embodiment of the present invention.

Fig. 4 shows the rotor-bearing assembly of Fig. 3 according to another embodiment of the present invention.

Fig. 5 shows a rotor-bearing assembly according to the present invention, with two hard elements;

5 **Fig. 6** shows a rotary sprinkler with an enlarged diameter tip of the rotor axle according to the present invention; and

Fig. 7 shows a rotor-bearing assembly with an enlarged diameter tip of the rotor axle and a hard disc insert according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

10 A typical dynamic rotary sprinkler known in the prior art was described above with reference to Fig. 1. A rotor-bearing assembly 40 of a similar rotary sprinkler in accordance with one embodiment of the present invention, is shown in Fig. 2A, without the sprinkler base and the connecting bridge, which are generally the same as in Fig. 1.

15 As shown in Fig. 2, the rotor-bearing assembly comprises the thrust bearing 14 and the rotor 16, both made of plastic material. The rotor 16 has an axle 38 with a tip 39, while the thrust bearing 14 has an axial socket 26 comprising a bore 28 and a bottom 30.

20 Furthermore, the bearing 14 is equipped with a wear-resistant insert 42 made of material which is much harder than the plastic material of the rotor and the bearing. The insert is a flat polished disc which is corrosion-proof in the field, i.e. in water solution of fertilizers and other chemicals. The disc may be made of industrial sapphire stone, industrial ruby stone, stainless steel, glass, ceramics or others.

25 The tip 39 abuts the hard insert 42 in a contact zone, forming a friction pair with lower friction coefficient than the pair of two plastic details tip-socket, whereby the wear of the tip and the socket in the contact zone is much lower. As shown in Fig. 2B, the disc 42 may be concave in the center in order to stabilize the position of the axle 38.

With reference to Fig. 3, another rotor-bearing assembly 50 is shown where the hard insert is in the form of a stainless steel ball 52 locked at the bottom of the socket 28. The tip 54 of the rotor axle 38 in this case is concave in order to stabilize the position of the axle 38. The hard insert may be as well fixed to the axle tip, as shown in Fig. 4 for a rotor-bearing assembly 60, where a stainless steel ball 62 is locked in the tip 64 of the axle 38.

As shown in Fig. 5, the friction pair of the present invention in a rotor-bearing assembly 70, may be constituted by two hard elements: a pin 66 embedded in the tip 64 of the rotor axle 38, and a hard insert 42 locked in the socket 28. Such friction pair would provide even lower friction and wear.

Fig. 6 illustrates a rotary sprinkler 80 with an enlarged axle tip according to another aspect of the present invention. The rotary sprinkler 80 has a thrust bearing 14 with a socket 82 formed as a cylinder bore of diameter D_0 and depth L_0 . The axle 38 has length L_3 greater than L_0 so that the axle can be axially displaced inside the socket 82 within a distance $\ell < L_0$ from the bottom. The tip 84 of the axle has diameter D_1 close to D_0 and short axial length $L_1 \ll L_0$, while the remainder major part of the axle 38, with length L_2 , has narrower diameter D_2 .

Enlarging the diameter of the rotor axle tip 84 prevents penetration of contaminating particles into the contact zone between the tip 84 and the socket 82, both in the lower position of the rotor shown in Fig. 6, where the tip is aligned with the bore opening, and in the upper (operative) position, where the tip abuts the bottom (seen in Fig. 7). As the enlarged tip 84 length L_1 is much shorter than the bore length L_0 , an open annular gap is formed below the tip, between the socket peripheral wall and the narrower part L_2 of the axle 38, when the rotor is in the upper position. Thus, even if a contaminating particle is entrapped in the contact zone as the rotor jumps to the operative position, the particle is very likely to fall out via the gap without causing much wear. The gap also prevents jamming of the axle in the socket, which would be very likely, if a substantial part of the axle had diameter close to the bore diameter D_0 .

As shown in Fig. 7, a rotary sprinkler 90 of the present invention may have both a short enlarged tip 84 in a cylinder bore, and a friction-reducing insert 42, to obtain double effect.

Although a description of specific embodiments has been presented, it is
5 contemplated that various changes could be made without deviating from the scope of the present invention. For example, the enlarged tip of the present invention may be formed as a ball, cylinder, cone, etc., or the socket may be not exactly cylindrical.

CLAIMS:

1. A rotary sprinkler comprising a rotor with an axle having a tip, and a thrust bearing with a socket having a bottom, said socket being adapted to receive for rotation said axle so that said tip abuts said bottom in a contact zone, wherein said
5 sprinkler further comprises at least one hard element constituting at least a part of said bottom or said tip located in said contact zone, said element being made of harder material than said axle or said socket.
2. The rotary sprinkler of Claim 1, wherein said sprinkler is dynamic.
3. The rotary sprinkler of Claim 1, wherein said hard element is able to
10 reduce wear of said tip or said bottom in said contact zone.
4. The rotary sprinkler of Claim 1, wherein said hard element has polished surface in the contact zone.
5. The rotary sprinkler of Claim 1, wherein said hard element is formed as one of the following: a plate, a ball and a pin.
- 15 6. The rotary sprinkler of Claim 1, wherein said hard element has concave surface in the contact zone.
7. The rotary sprinkler of Claim 1, wherein said hard element is made of one of the following: industrial sapphire stone, industrial ruby stone, ceramics, glass, and stainless steel.
- 20 8. The rotary sprinkler of Claim 1, wherein said hard element is a stainless steel ball locked in the bottom of said socket.
9. The rotary sprinkler of Claim 8, wherein said tip is concave.
10. The rotary sprinkler of Claim 1, wherein said hard element is a ball or a pin constituting part of said tip.
- 25 11. The rotary sprinkler of Claim 1, comprising two hard elements, one at said tip and one at said bottom.
12. The rotary sprinkler of Claim 1, wherein said socket has an inlet opening of diameter D0 and a peripheral wall between said inlet opening and said bottom, said socket being adapted to receive slidably said axle through said inlet opening,

wherein said tip has diameter $D1$ close to $D0$ while an adjacent portion of said axle has diameter $D2 < D1$, such that, when said tip abuts said bottom, an open annular gap is formed between said axle and said peripheral wall, and when said tip is aligned with said inlet opening, said inlet opening is essentially closed.

5 13. The rotary sprinkler of Claim 12, wherein said tip is formed as one of the following: a ball, a cylinder, a cone, a disc, or another body of rotation.

14. A hard element for use in a rotary sprinkler comprising a rotor with an axle having a tip, and a thrust bearing with a socket having a bottom, said socket being adapted to receive for rotation said axle so that said tip abuts said bottom in a
10 contact zone, said hard element constituting at least a part of said bottom or said tip located in said contact zone, said hard element being made of harder material than said axle or said socket.

15. The hard element of Claim 14, wherein said hard element is able to reduce wear of said tip or said bottom in said contact zone.

15 16. The hard element of Claim 14, wherein said hard element has polished surface in the contact zone.

17. The hard element of Claim 14, wherein said hard element is formed as one of the following: a plate, a ball and a pin.

18. The hard element of Claim 14, wherein said hard element has concave
20 surface in the contact zone.

19. The hard element of Claim 14, wherein said hard element is made of one of the following: industrial sapphire stone, industrial ruby stone, ceramics, stainless steel, and glass.

20. A rotary sprinkler comprising a rotor with an axle having a tip, and a thrust
25 bearing with a socket having an inlet opening of diameter $D0$, a bottom and a peripheral wall therebetween, said socket being adapted to receive slidably and rotatably said axle through said inlet opening so that said tip can abut said bottom, wherein said tip has diameter $D1$ close to $D0$, while an adjacent portion of said axle has diameter $D2 < D1$, such that, when said tip abuts said bottom, an open annular

gap is formed between the axle and the peripheral wall, and when said tip is aligned with said inlet opening, said inlet opening is essentially closed.

21. The rotary sprinkler of Claim 20, wherein said tip is formed as one of the following: a ball, a cylinder, a cone, a disc, or as a combination of said forms.

ABSTRACT

A rotary sprinkler comprising a rotor with an axle having a tip, and a thrust bearing with a socket having a bottom, the socket being adapted to receive for rotation the axle so that the tip abuts the bottom in a contact zone. The sprinkler
5 further comprises a hard element constituting a part of the bottom or of the tip. The hard element is made of harder material than the axle or the socket, thereby reducing their wear.

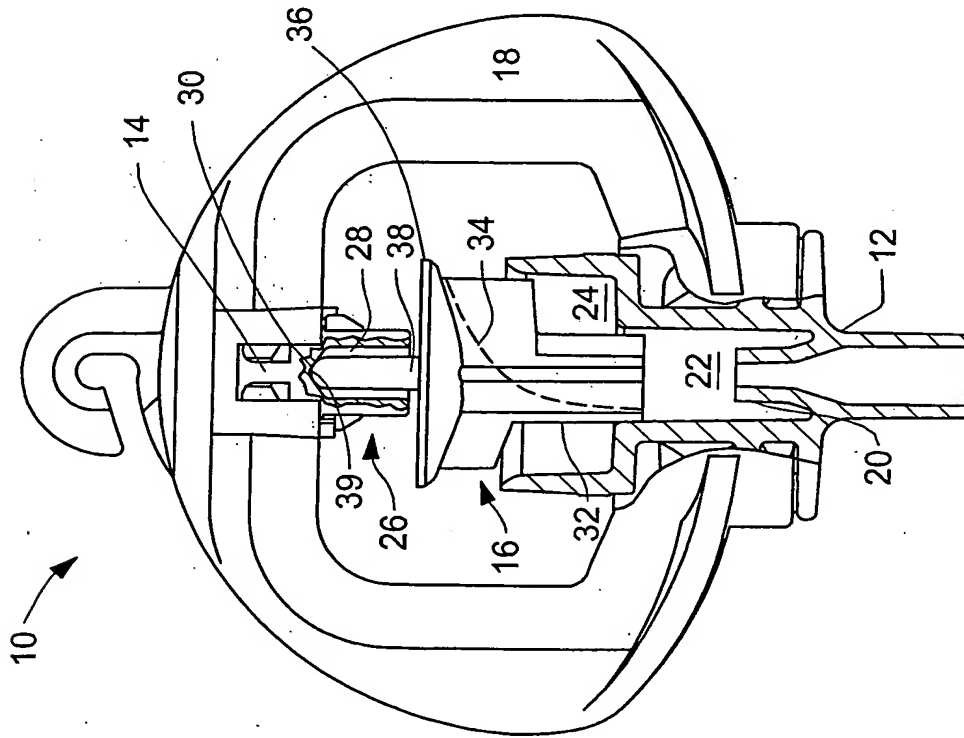


FIG. 1
(PRIOR ART)

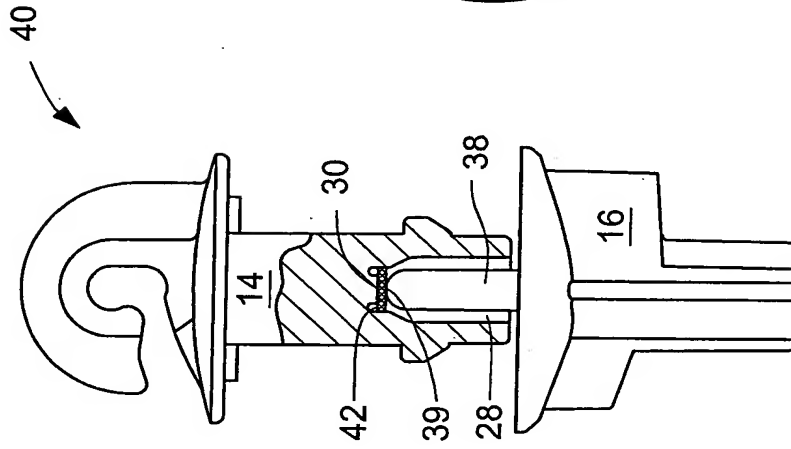


FIG. 2A

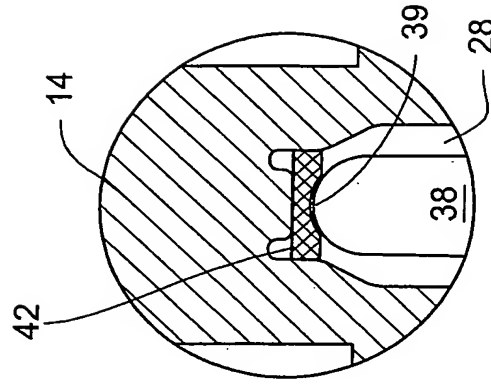


FIG. 2B

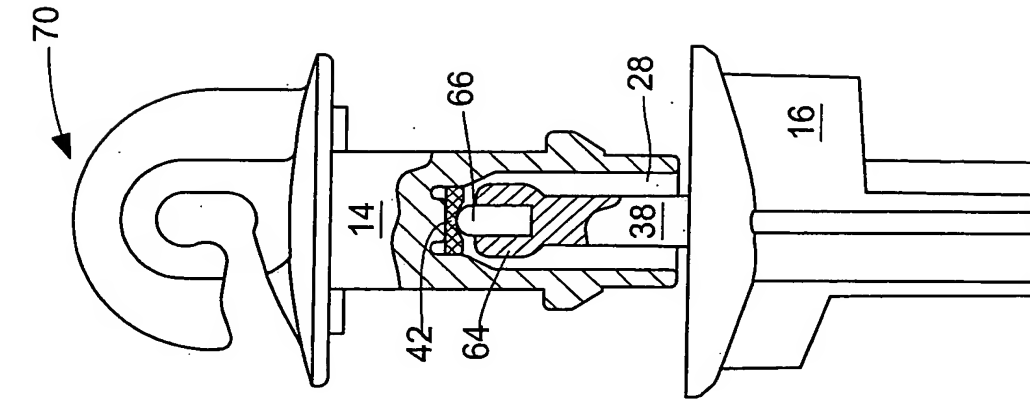


FIG. 5

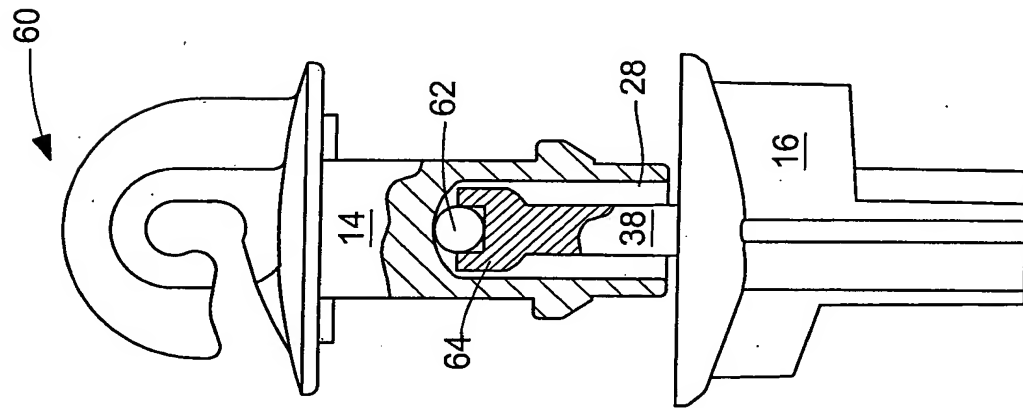


FIG. 4

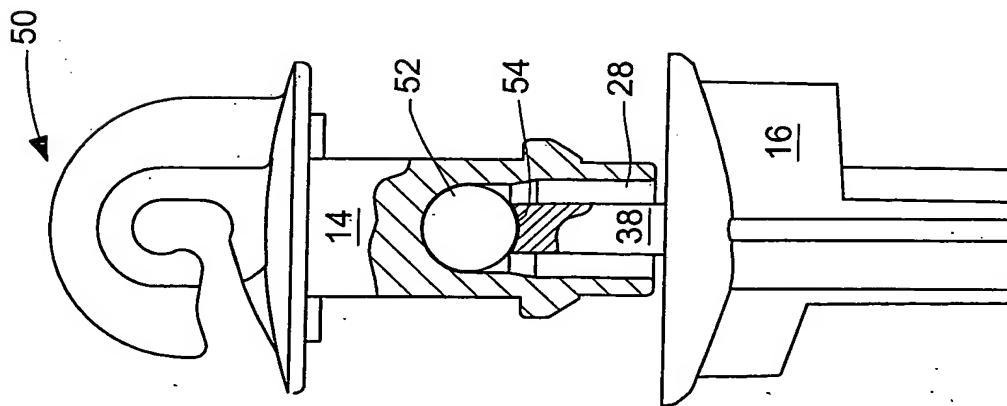


FIG. 3

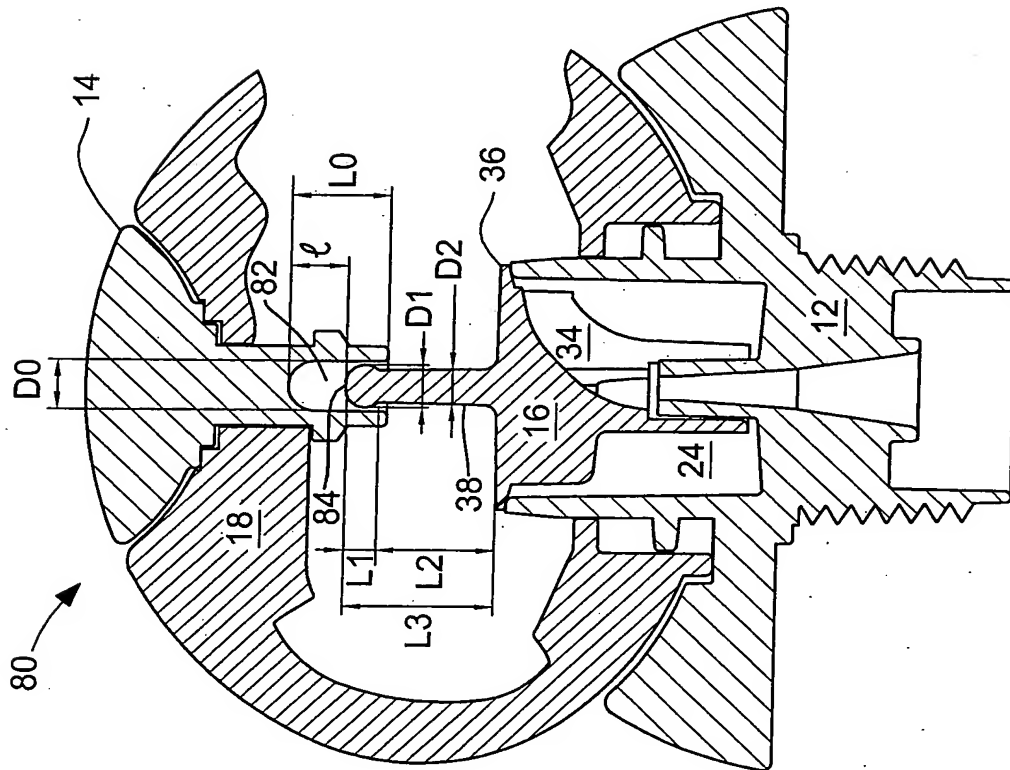


FIG. 6

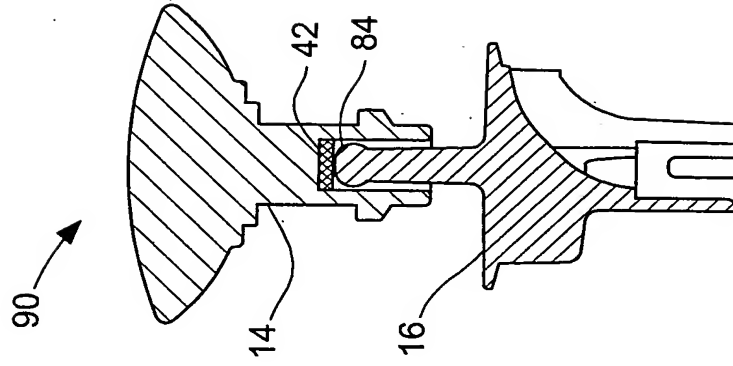


FIG. 7

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